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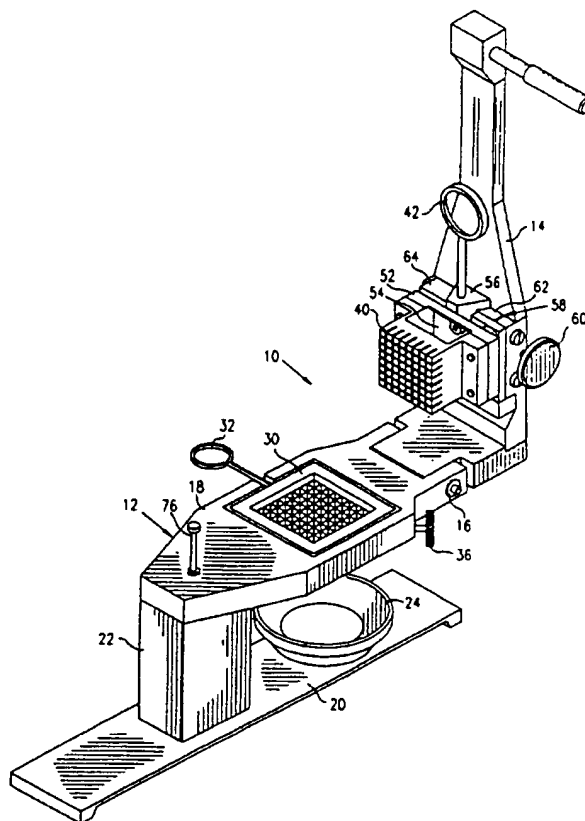
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(54) Title: APPARATUS FOR MECHANICAL SEPARATION OF PLANT TISSUE CULTURE

(57) Abstract

Apparatus for the cutting of plant tissue culture, including an array of cutting blades (30) and an array of forcing elements (40) having thru-gaps such that residual material can pass thru the thru-gaps and avoid clogging the array of forcing elements (40).



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APPARATUS FOR MECHANICAL SEPARATION OF PLANT TISSUE CULTURE

The present invention relates to apparatus and methods for mechanical separation of plant tissue culture.

Various methods for mechanical separation of plant tissue culture are known. For example, Levin, in United States Patent 4,855,236, describes a method for mechanical separation of plant tissue culture by homogenization. In addition, methods for separation of plant tissue culture using a dicing type cutter are known (Weston et al., Meeting Abs. and Alper et al., ASAE Meeting 7502-1992).

The device described by Alper et al. employs a wire grid cutter which is too weak to cut hard cultures such as banana. Furthermore, the commercial vegetable dicer (Urschel International Model CD Grosby, Leicester, UK) employed by Weston et al. uses a two-dimensional two cutting element apparatus with both circular and cross-cutting knives which is a bulky apparatus, and is hard to sterilize.

The present invention seeks to provide improved apparatus and methods for mechanical separation of plant tissue culture. Apparatus of the present invention substantially does not clog and preferably includes removable and autoclavable cutting blades and forcing elements.

There is thus provided in accordance with a preferred embodiment of the present invention, apparatus for mechanical separation of plant tissue culture including an array of cutting blades fixedly arranged for placement thereupon of plant tissue culture, and an array of forcing elements, each mutually spaced from each other by a gap, at least some of the gaps being fully open to

allow passage therethrough of material, the array of forcing elements being arranged for movement relative to the array of cutting blades, wherein movement of the array of forcing elements against the plant tissue culture in a first direction causes the plant tissue culture to be forced through and cut by the array of cutting blades, and further causes residual material from the plant tissue culture to substantially pass through the fully open gaps in a second direction generally opposite to the first direction, and causes the residual material to be substantially transferred to a space generally adjacent the array of forcing elements, thereby substantially preventing the residual material from clogging the array of forcing elements.

Preferably at least some of the fully open gaps become wider along the second direction. Additionally, at least some of the forcing elements are preferably tapered in the first direction.

In accordance with a preferred embodiment of the present invention, the array of cutting blades and/or the array of forcing elements are autoclavable.

Additionally in accordance with a preferred embodiment of the present invention, apparatus includes a stand which has a recess formed therein, wherein the array of cutting blades is fixedly mountable in and removable from the recess.

Further in accordance with a preferred embodiment of the present invention, apparatus includes an adjustment device for accurately fixing the array of cutting blades in the recess.

Still further in accordance with a preferred embodiment of the present invention, the adjustment device includes a threaded fastener which is arranged for selectively and fixedly pushing the array of cutting blades against at least one accurate surface of the recess.

Additionally in accordance with a preferred embodiment of the present invention, apparatus includes an arm arranged for movement relative to the stand, wherein the array of forcing elements is fixedly attachable to and removable from the arm.

Further in accordance with a preferred embodiment of the present invention, apparatus includes an adjustment device for accurately fixing the array of forcing elements to the arm in a predetermined relationship with the array of cutting blades.

Still further in accordance with a preferred embodiment of the present invention, a shock absorber is provided for absorbing shocks during motion of the arm with respect to the stand.

In accordance with a preferred embodiment of the present invention, the arm is arranged for pivotal movement relative to the stand.

In accordance with another preferred embodiment of the present invention, apparatus includes a drive device for moving the array of forcing elements in the first direction.

Preferably the array of cutting blades and the array of forcing elements are each provided with a handle.

There is also provided in accordance with a preferred embodiment of the present invention, a method for mechanical separation of plant tissue culture including the steps of providing an array of cutting blades, placing plant tissue culture on the array of cutting blades, providing an array of forcing elements, each mutually spaced from each other by a gap, at least some of the gaps being fully open to allow passage there-through of material, the array of forcing elements being arranged for movement relative to the array of cutting blades, and moving the array of forcing elements against the plant tissue culture in a first direction, thereby

causing the plant tissue culture to be forced through and cut by the array of cutting blades, and further causing residual material from the plant tissue culture to substantially pass through the fully open gaps in a second direction generally opposite to the first direction, and causing the residual material to be substantially transferred to a space generally adjacent the array of forcing elements, thereby substantially preventing the residual material from clogging the array of forcing elements.

The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

Fig. 1 is a simplified pictorial illustration of apparatus for mechanical separation of plant tissue culture, constructed and operative in accordance with a preferred embodiment of the present invention;

Fig. 2 is a simplified pictorial illustration of an array of cutting blades of apparatus of Fig. 1;

Fig. 3 is a simplified pictorial illustration of an array of forcing elements of apparatus of Fig. 1;

Fig. 4 is a simplified sectional illustration of a portion of the array of forcing elements, taken along lines IV - IV in Fig. 3;

Fig. 5 is a simplified side view illustration of plant tissue culture placed between the arrays of cutting blades and forcing elements, prior to cutting;

Fig. 6 is a simplified side view illustration of plant tissue culture being cut by apparatus of Fig. 1;

Fig. 7 is a simplified front view illustration of plant tissue culture being cut by apparatus of Fig. 1 and residual material being pushed through gaps in the array of forcing elements, Fig. 7 being viewed along arrow VII in Fig. 6; and

Fig. 8 is a simplified side view illustration of apparatus for mechanical separation of plant tissue

culture, constructed and operative in accordance with another preferred embodiment of the present invention.

Reference is now made to Fig. 1 which illustrates apparatus 10 for mechanical separation of plant tissue culture, constructed and operative in accordance with a preferred embodiment of the present invention.

Apparatus 10 preferably includes a stand 12 and an arm 14 pivotally attached thereto about a pivot 16. Stand 12 preferably includes a plate 18 fixedly attached to a base 20 by means of a spacer 22. Plate 18 is generally parallel to base 20, and spacer 22 provides room for a collection container 24 to be placed between plate 18 and base 20.

Reference is now additionally made to Fig. 2. Plate 18 is preferably formed with a recess 26 in which an array of cutting blades 30 may be fixedly mounted and removed therefrom. It is a particular feature of the present invention that the array of cutting blades 30 is autoclavable, such as for sterilization purposes. The array of cutting blades 30 may be constructed of stainless steel or other autoclavable material. Preferably, the array of cutting blades 30 is provided with a handle 32 for ease of handling and for helping to prevent contamination of any plant tissue culture. The cutting blades 30 are preferably arranged in a matrix of mutually perpendicular columns and rows, although any other arbitrary arrangement suitable for cutting plant tissue culture is also acceptable.

Recess 26 is preferably provided with one or more accurately machined surfaces 34, as seen in Fig. 2. Preferably a threaded fastener 36 is threadably attached to plate 18 and may be turned and advanced to protrude into recess 26. As seen in Fig. 1, the array of cutting blades 30 may be placed in recess 26 and threaded fastener 36 may be selectively advanced to push the array of cutting blades 30 against accurate surfaces 34, thereby

accurately positioning the array of cutting blades 30 in recess 26. Thus, threaded fastener 36 acts as an adjustment device for accurately fixing the array of cutting blades 30 in recess 26.

As seen in Fig. 2, recess 26 is preferably provided with an aperture 38 for allowing passage therethrough of cut plant tissue culture.

Referring again to Fig. 1 and additionally to Fig. 3, it is seen that apparatus 10 preferably includes an array of forcing elements 40. It is a particular feature of the present invention that the array of forcing elements 40 is autoclavable, such as for sterilization purposes. The array of forcing elements 40 may be constructed of stainless steel or other autoclavable material. Preferably, the array of forcing elements 40 is provided with a handle 42 for ease of handling and for helping to prevent contamination of any plant tissue culture. The forcing elements 40 are preferably arranged to correspond to the arrangement of the cutting blades 30, such as in a matrix of mutually perpendicular columns and rows.

The forcing elements 40 are preferably mutually spaced from each other by a gap. Preferably in the illustrated embodiment, a first set of generally parallel gaps 44 are provided which are generally mutually perpendicular to a corresponding second set of generally parallel gaps 46. Gaps 44 are not cut through the entire thickness of the array of forcing elements 40 and thus do not allow passage therethrough of any material. In contrast to gaps 44, gaps 46 are fully open to allow passage therethrough of material.

Reference is now made Fig. 4 which is a simplified sectional illustration of a portion of the array of forcing elements 40. It is seen that at least some, and preferably all of gaps 46 become wider in the direction of an arrow 48, such as by means of a counterbore 49.

Alternatively, gaps 46 may become wider by having a cross section like a trapezoid. Preferably at least some of the forcing elements 40, such as the outer ones, are tapered in the direction of an arrow 50, generally opposite to the direction of arrow 48.

Referring again to Figs. 1 and 3, it is seen that the array of forcing elements 40 is preferably attached to a base 52 and separated therefrom by a space 54. Base 52 is preferably attached to a dovetail shaped wedge 56, handle 42 (Fig. 1) preferably being attached to wedge 56. In Fig. 1, it is seen that wedge 56 is preferably mounted to arm 14 by a clamp 58 which preferably includes an adjustment knob 60 and a pair of wedge clamps 62 and 64. Wedge clamp 62 is preferably spring-loaded. Wedge 56 and wedge clamps 62 and 64 are preferably configured and located such that when wedge 56 is clamped between wedge clamps 62 and 64 by suitable turning of knob 60, the array of forcing elements 40 is accurately fixed and is poised to be in a cutting relationship with the array of cutting blades 30, as will be described with reference to Figs. 5 - 7.

Reference is now made to Figs. 5 which illustrates plant tissue culture 70 placed between the arrays of cutting blades 30 and forcing elements 40, prior to cutting. It is seen that arm 14 has been rotated about pivot 16, generally in the direction of an arrow 62.

Reference is now made to Fig. 6 which shows further rotation of arm 14 and forcing elements 40 generally in the direction of arrow 62, thereby causing plant tissue culture 70 to be forced through and cut by the array of cutting blades 30. Accurately cut plant tissue material 72 is preferably collected in collection container 24.

Referring additionally to Fig. 7, it is seen that the array of forcing elements 40 not only cut plant tissue culture 70, but also cause residual material 74

from plant tissue culture 70 to substantially pass through fully open gaps 46 generally in the direction of arrow 48. Residual material 74 is substantially transferred to space 54 and does not substantially clog the array of forcing elements 40. Since gaps 46 are fully open, most of the residual material 74 tends to flow away from the closed gaps 44 (not seen in Fig. 7) and is forced through gaps 46.

Referring again to Fig. 1, it is seen that a shock absorber 76 is preferably attached to plate 18 for absorbing shocks during motion of arm 14 with respect to stand 12.

Reference is now made to Fig. 8 which illustrates apparatus 80 for mechanical separation of plant tissue culture, constructed and operative in accordance with another preferred embodiment of the present invention.

Apparatus 80 is similar to apparatus 10 described hereinabove with reference to Figs. 1 - 7, like elements being designated with like numbers. Apparatus 80 differs from apparatus 10 in the manner in which forcing elements 40 are moved towards cutting blades 30. Apparatus 80 preferably includes a drive device 82, such as a pneumatic, hydraulic, electrical or mechanical piston, which drives forcing elements 40 towards cutting blades 30 in the direction of an arrow 84. One or more guides 86 may be provided for guiding the motion of the array of forcing elements 40.

It is appreciated that various features of the invention which are, for clarity, described in the contexts of separate embodiments may also be provided in combination in a single embodiment. Conversely, various features of the invention which are, for brevity, described in the context of a single embodiment may also be provided separately or in any suitable subcombination.

It will be appreciated by persons skilled in

the art that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined only by the claims which follow:

C L A I M S

1. Apparatus for mechanical separation of plant tissue culture comprising:
 - an array of cutting blades fixedly arranged for placement thereupon of plant tissue culture; and
 - an array of forcing elements, each mutually spaced from each other by a gap, at least some of the gaps being fully open to allow passage therethrough of material, said array of forcing elements being arranged for movement relative to said array of cutting blades, wherein movement of said array of forcing elements against said plant tissue culture in a first direction causes said plant tissue culture to be forced through and cut by said array of cutting blades, and further causes residual material from said plant tissue culture to substantially pass through said fully open gaps in a second direction generally opposite to said first direction, and causes said residual material to be substantially transferred to a space generally adjacent said array of forcing elements, thereby substantially preventing said residual material from clogging said array of forcing elements.
2. Apparatus according to claim 1 and wherein at least some of said fully open gaps become wider along said second direction.
3. Apparatus according to claim 1 and wherein at least some of said forcing elements are tapered in said first direction.
4. Apparatus according to claim 1 and wherein at least one of said array of cutting blades and said array of forcing elements is autoclavable.

5. Apparatus according to claim 1 and comprising a stand which has a recess formed therein, wherein said array of cutting blades is fixedly mountable in and removable from said recess.

6. Apparatus according to claim 5 and comprising an adjustment device for accurately fixing said array of cutting blades in said recess.

7. Apparatus according to claim 6 and wherein said adjustment device comprises a threaded fastener which is arranged for selectively and fixedly pushing said array of cutting blades against at least one accurate surface of said recess.

8. Apparatus according to claim 5 and comprising an arm arranged for movement relative to said stand, wherein said array of forcing elements is fixedly attachable to and removable from said arm.

9. Apparatus according to claim 8 and comprising an adjustment device for accurately fixing said array of forcing elements to said arm in a predetermined relationship with said array of cutting blades.

10. Apparatus according to claim 8 and comprising a shock absorber for absorbing shocks during motion of said arm with respect to said stand.

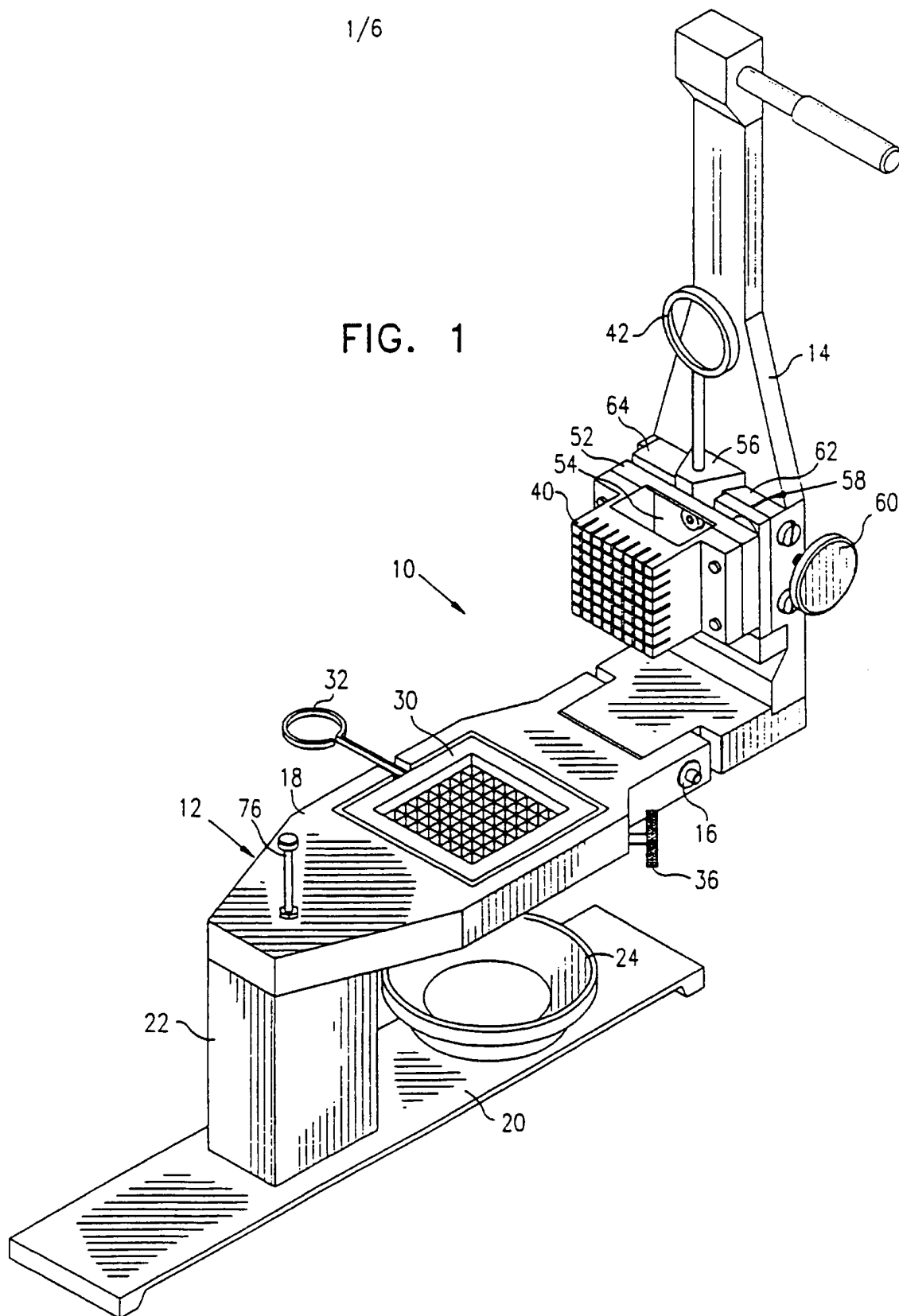
11. Apparatus according to claim 8 and wherein said arm is arranged for pivotal movement relative to said stand.

12. Apparatus according to claim 1 and comprising a drive device for moving said array of forcing elements in said first direction.

13. Apparatus according to claim 1 and wherein said array of cutting blades is provided with a handle.
14. Apparatus according to claim 1 and wherein said array of forcing elements is provided with a handle.
15. A method for mechanical separation of plant tissue culture comprising the steps of:
- providing an array of cutting blades;
 - placing plant tissue culture on said array of cutting blades;
 - providing an array of forcing elements, each mutually spaced from each other by a gap, at least some of the gaps being fully open to allow passage there-through of material, said array of forcing elements being arranged for movement relative to said array of cutting blades; and
 - moving said array of forcing elements against said plant tissue culture in a first direction, thereby causing said plant tissue culture to be forced through and cut by said array of cutting blades, and further causing residual material from said plant tissue culture to substantially pass through said fully open gaps in a second direction generally opposite to said first direction, and causing said residual material to be substantially transferred to a space generally adjacent said array of forcing elements, thereby substantially preventing said residual material from clogging said array of forcing elements.

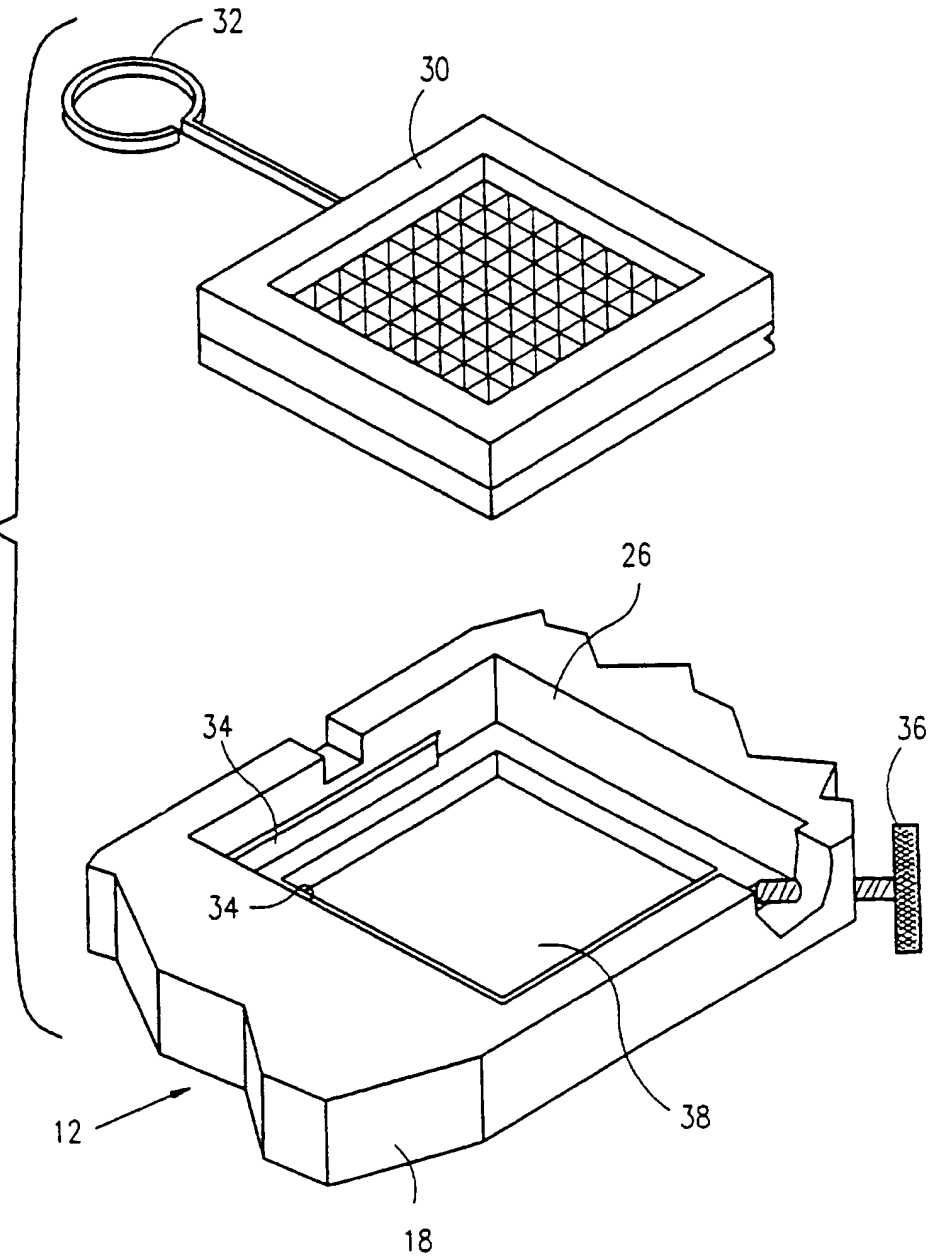
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FIG. 1



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FIG. 2



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FIG. 3

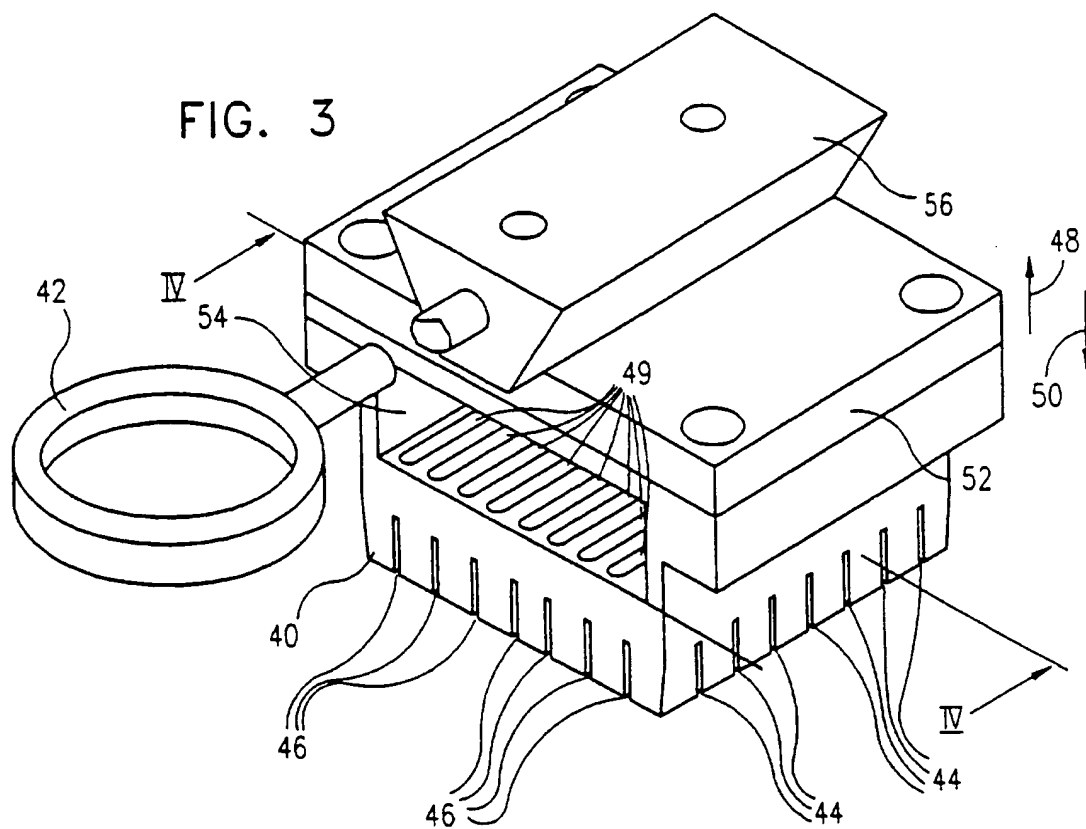
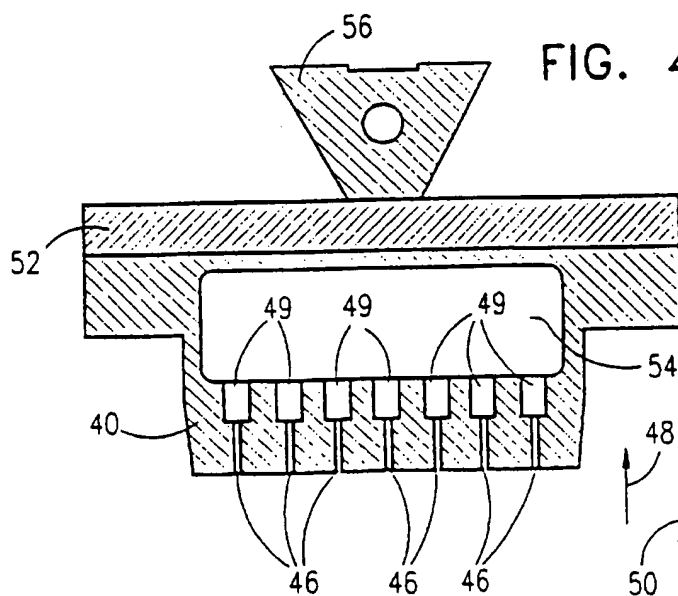
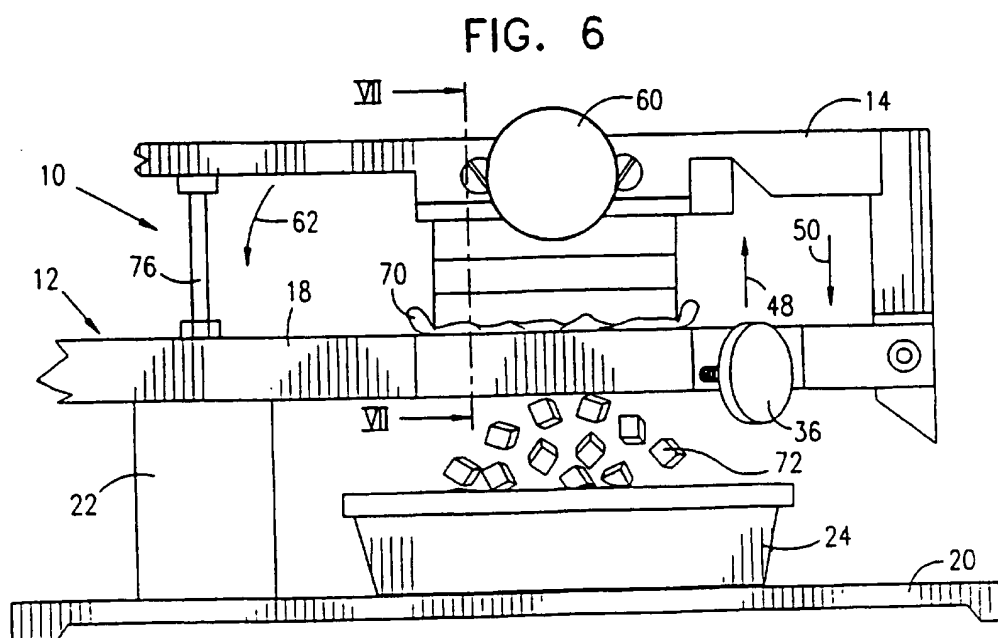
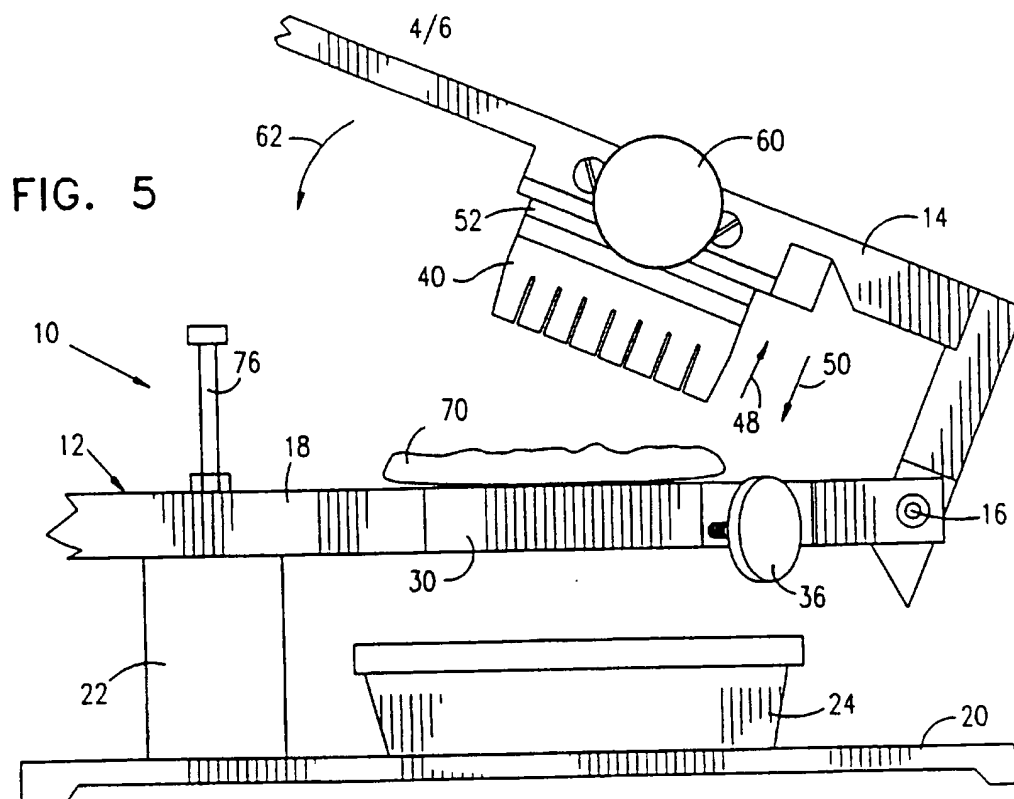


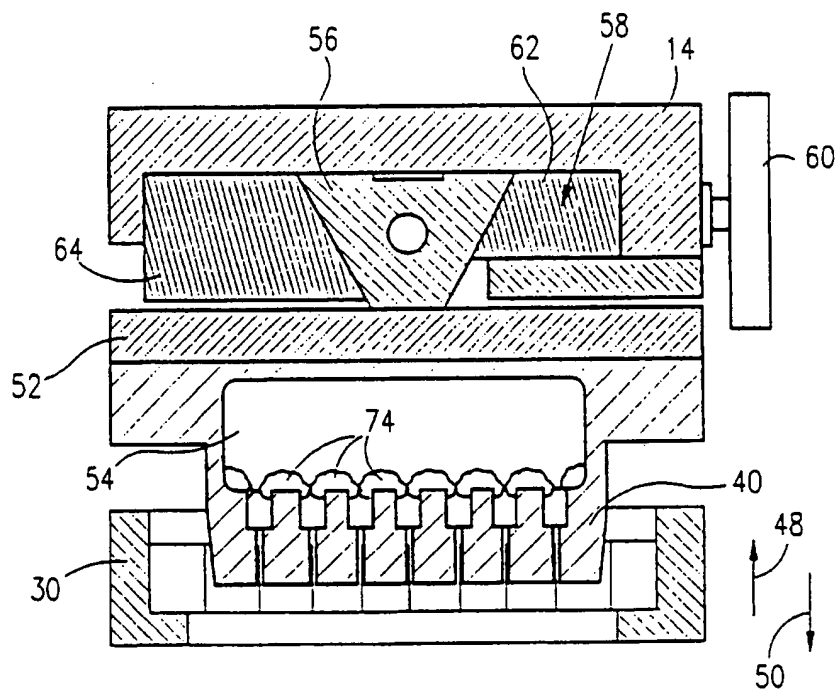
FIG. 4





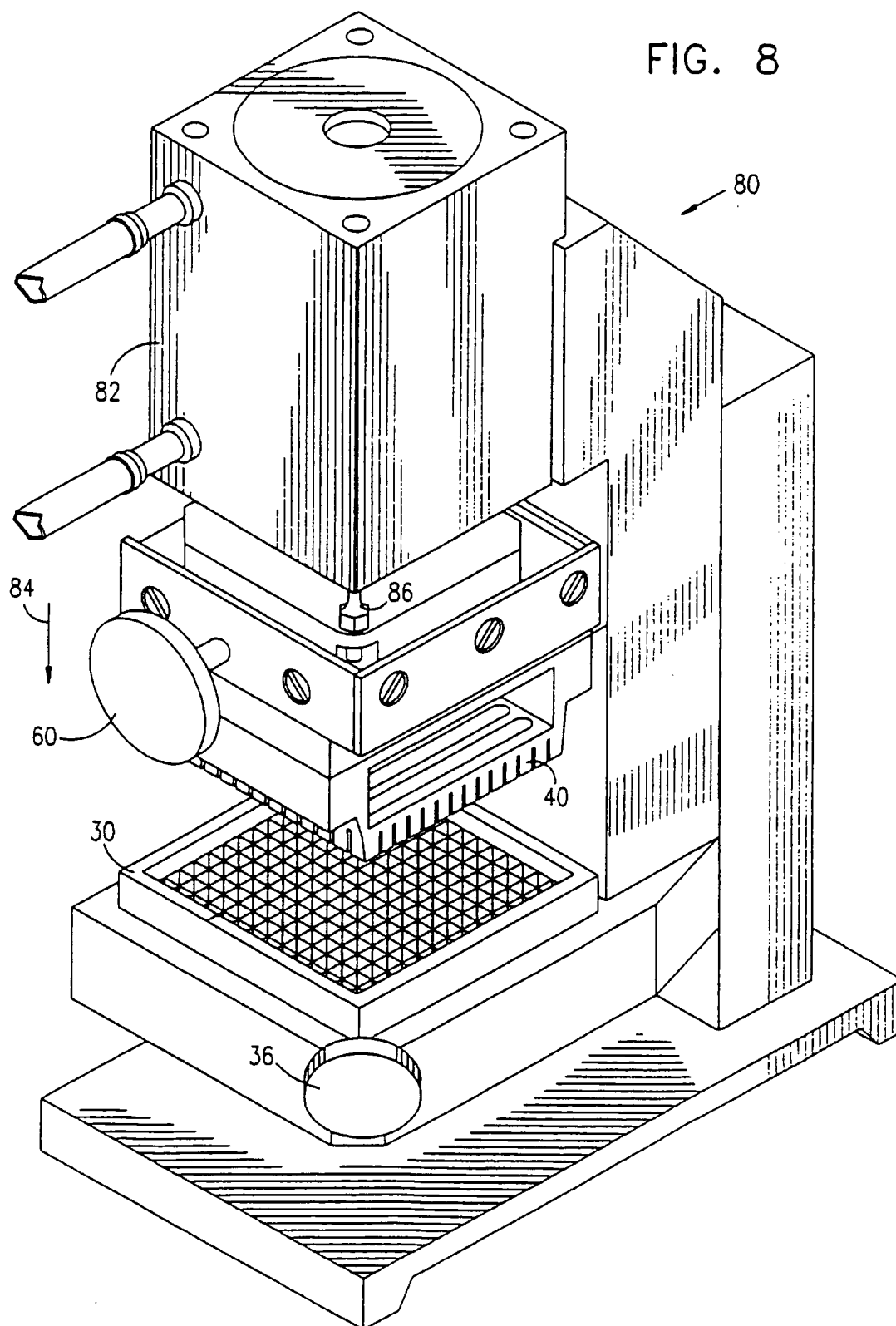
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FIG. 7



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FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/05934

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : B26D 1/03

US CL : 83/857

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 83/857,858,651.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS = > s shock absorber and (83/857,858/cclst)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 2,245,978 (HYLAND) 17 JUNE 1941, See figure 3, screw 12	1-15
Y	US, A, 3,145,743 (CRONHEIM) 25 August 1964, see figure 4, gap 34	1-15
Y	FR, A, 952,078 (BARANES) 09 November 1949, see handles 2 and 3	13,14
Y	US, A, 4,302,997 (JONES ET AL.) 01 December 1981, see shock absorber 88	10
A	US, A, 4,579,028 (NEIDHADT) 01 April 1986, see figure 1	1-15
A	US, A, 2,240,221 (LOCKER) 29 April 1941, see figure 3	1-15

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 ☐ See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/05934

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,346,634 (JONES) 31 August 1982, see figure 1.	1-15
A	US, A, 5,245,902 (PEREIRA) 21 September 1993, see figure 1	1-15

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